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ABSTRACT

The inverse relation between academic motivation and substance use has been well established, but the direction of the influence remains to be specified; two possible influences are the mediating and moderating effects of family relationships and self-esteem. In this study, investigators used General Estimating Equation (GEE) models based on data from four annual assessments of adolescents, 12 to 16 years of age. The adolescents' mothers were included in the study. Families were recruited from moderate-sized northwestern urban areas; 91.7 percent of the participants were Caucasian. The results suggest that substance use leads to a decrease in academic motivation one year later. However, the data did not support a direct path of academic motivation to substance use, as researchers found mediating effects for alcohol use and moderating effects for cigarette and marijuana use for both males and females. A somewhat surprising result was that for boys and older girls, good family relationships increased the inverse effect of academic motivation on marijuana use. This may be due to the additional pressures that parents from families with good relationships place on their children for academic success. Eight tables present the statistical summaries for this study. Contains 24 references. (RJM)

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EXPLAINING THE RELATION BETWEEN ACADEMIC MOTIVATION AND SUBSTANCE USE: EFFECTS OF FAMILY RELATIONSHIPS AND SELF ESTEEM

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An inverse relation between academic motivation and substance use has been well established, but the direction of the influence remains to be specified. Using General Estimating Equation (GEE) models based on data from four annual assessments of adolescents, 12 to 16 years of age at the first assessment, and their mothers, the mediating and moderating effects of both family relationships and self esteem on the relation between academic motivation and substance use were examined. The results suggested that substance use leads directly to a decrease in academic motivation one year later. However, the results indicated that the path from academic motivation to substance use is not direct. Self esteem and family relationships mediated and moderated the relation between academic motivation and substance use.

INTRODUCTION

An inverse relation between academic motivation and substance use has been well established (Bradley, 1982; Marston et al., 1988) that appears to be bidirectional (Andrews, Smolkowski, et al., 1991). Researchers have found that substance use is predictive of graduation from high school and lack of college involvement (Newcomb & Bentler, 1986) and that low academic aspirations (Engel et al., 1987; Waldron & Lye, 1988) have an influence on substance use onset. However, this relation between substance use and achievement motivation may well be spurious, explained by a third variable. Alternatively, the paths between substance use and academic motivation may not be direct, but may be mediated by a third variable, or a third variable may moderate this relation.

Relationships within the adolescent's family and the self esteem of the adolescent were two variables hypothesized to explain, mediate, or moderate the relation between substance use and academic motivation. Risk factors of substance use commonly cited in the literature include lack of warmth within the family (e.g., Andrews, Hops, et al., 1991; Kandel, Kessler, & Marguiles, 1978; see: Hawkins et al., 1986, for review) and poor self esteem (Kaplan, Martin, Johnson, & Robbins, 1986). Warmth in families (Forehand, Long, Brody, & Fauber,

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1986; Steinberg, Elmen, & Mounts, 1989; Stein & Bailey, 1973) and good self esteem (Dweck & Elliot, 1983) have also been positively related to academic motivation.

Using General Estimating Equation (GEE) models, the serial fluctuations between academic motivation and substance use across four annual assessments were examined. Lagged models were used to examine directional relations and the mediating and moderating effects of self esteem and family relationships on this relation were examined. A feature of the design of this study is the use of multi-agent constructs to provide more valid and reliable measures of theoretical constructs. Two constructs, family relationships and academic motivation, are based on reports from both the mother and the target adolescent.

METHOD

Sample

Subjects in this study were participants in a 12-year longitudinal investigation of family and peer influences on adolescent substance use. Families were recruited from moderate-sized northwestern urban areas via newspaper, television, and radio announcements. At T1, the sample consisted of 763 families: 368 (48.2%) single-parent and 395 either married or living in a committed relationship. Target adolescents included 374 males (49.0%) and 389 females aged 11 to 15 years of age at the first assessment. A majority of the participants were Caucasian (91.7%).

This study was based on data obtained from 650 (331 females [50.9%]; 319 males) adolescents who participated in the second through the fifth annual assessments. The target adolescents were primarily Caucasian (92.5%), 46.1% lived in single parent households, and their mean age at the first assessment (T1) was 14.19 (s.d. = 1.56).

At all four assessments, targets and parents separately completed a series of self-report questionnaires in our laboratory. Questions assessed their substance use and selected psychosocial characteristics. Families were paid $35 for their participation at each assessment.

Measures

Target's substance use. Target adolescents reported on both their status of alcohol, cigarette, and marijuana use and rate of use over the last week, month, and 6 months. Rate of use per month was calculated from these latter three rate variables. An ordinal scale of substance use was created from both the status and rate variables. Categories for all three substances were: (a) Never Used: Self-report of "never use" plus zero/month in the last six months; (b) Quit: Self-report of quitting the substance plus a rate of zero/month in the last six months; (c) Experimenter: Self report of lifetime use plus current use of less than 4/month; (d) Regular: Self report of current use, plus a rate of use between 4 and 29/month; (e) Heavy: Current use, plus 30 or more times per month.

Academic motivation. A construct of academic motivation was created from three variables, two based on the report of the adolescent, Expectation of Achievement (Jessor, 1987) and Value on Achievement (Jessor, 1987), and one based on the report of the parent, mother's perception of the adolescent's Value on Achievement (Jessor, 1987). This construct had an alpha of .75.

Family relationships. A construct of family relationships was created from adolescents' report on the Cohesion subscale of the Family Environment Scale (FES; Moos, 1974), the Perceived Supportiveness of Parents scale (Jessor, 1987), and the Appraisal of Mother subscale of the Conflict Behavior Questionnaire (Prinz et al., 1979), and the mothers' report on the Cohesion subscale of the FES.

Self esteem. Self esteem was measured using the target's report on one scale, the Global Self Worth subscale of the Self Perception Profile for Adolescents (Messer & Harter, 1986).

Analysis Method

General Estimating Equations (GEE), a strategy that uses a repeated measures methodology to examine the effects of independent variables on individual fluctuations of the dependent variables (Duncan et al., in press; Hops et al., 1993; Zeger & Liang, 1986), was used. With GEE, relations between independent and dependent variables may be either synchronous or lagged (independent variables predicting a dependent variable at a later time). Analyses were run separately by gender and age was included as a covariate, which remained in the model. In each case, backward elimination, eliminating non-significant main effects and interactions ($p>.05$) was used to arrive at the final model.

RESULTS

As can be seen in Table 1, alcohol, cigarette, and marijuana use were moderately correlated across time.

Table 2 presents the data from Model I, including the estimated regression coefficients and associated robust t-statistics for the synchronous generalized estimating equation. Under the assumptions of an exchangeable working correlation matrix and using age, academic motivation, and age X academic motivation as time-varying covariates, significant synchronous relationships were found between the serial fluctuations in academic motivation and the serial fluctuations in the use of alcohol, cigarettes, and marijuana for both males and females in most age groups. Explorations of the interactions of age and academic motivation revealed that the inverse relation between academic motivation and cigarette use was strongest for boys between 16 and 18 years of age. Other interactions indicated that the inverse relation between motivation and both alcohol and cigarette use was strongest for girls between 14 and 15 years of age.

Model II (Table 3) presents similar estimates, using a one-year time lag between the measurement of substance use and the academic motivation of the adolescent (e.g., substance use at T1, related to academic motivation at T2, etc.). For both males and females, the serial fluctuations in cigarette and marijuana use were inversely related to the serial fluctuations in academic motivation one year later.

TABLE 1. CORRELATION OF SUBSTANCE USE (ACROSS OBSERVATIONS)

	Males (obs = 1017)		Females (obs = 1077)	
	Cigarettes	Marijuana	Cigarettes	Marijuana
Alcohol	.44	.52	.54	.49
Cigarettes		.65		.64

TABLE 2. GEE MODEL: SYNCHRONOUS RELATION BETWEEN ACADEMIC MOTIVATION AND SUBSTANCE USE

	Male (n = 319, obs = 1020)						Female (n = 331, obs = 1075)					
	Alcohol		Cigarettes		Marijuana		Alcohol		Cigarettes		Marijuana	
	β	t	β	t	β	t	β	t	β	t	β	t
Age	.18	10.65***	.18	9.55***	.15	7.98***	.18	11.58***	.15	7.13***	.11	6.84***
Academic motivation	-.03	-2.45*	.13	1.32	-.07	-4.61***	-.29	-3.11***	-.51	-4.12***	-.05	-4.05***
Age X Academic motivation			-.01	-2.16*			.01	2.48*	.02	3.31***		

For females only, the serial fluctuation in alcohol use was inversely related to the lagged serial fluctuations in academic motivation. All interactions with age were not significant.

Model IIa (Table 4) is Model II, the one year lag model, with family relationships, interactions between substance use and family relationships, and interactions of family relationships with age added to the model as covariates. Fluctuations in cigarette and marijuana use, and for females, alcohol use, continued to be significantly related to fluctuations in academic motivation. For females only, the fluctuation in family relationships was independently related to the lagged fluctuations in academic motivation. Interactions of substance use and family relationships with substance use and all interactions with age were not significant.

Model IIb (Table 5) is Model II, the one year lag model, with self esteem, interactions between substance use and self esteem, and interactions of self esteem with age added to the model as covariates. Fluctuations in self esteem were not related to the lagged fluctuations in substance use. The interactions of self esteem with substance use and interactions with age were not significant.

Table 6, Model III, uses a one-year time lag, with the measurement of academic motivation preceding the measurement of the substance

TABLE 3. MODEL II: ONE YEAR LAG GEE MODEL: SUBSTANCE USE PREDICTING ACADEMIC MOTIVATION

	Males (n = 297, obs = 703)		Females (n = 302, obs = 745)	
	β	t	β	t
Alcohol use				
Age	-.13	-2.12*	-.03	-.54
Alcohol use	.17	1.80	-.23	-2.30*
Cigarette use				
Age	.01	.23	-.01	-.24
Cigarette use	-.44	-4.39***	-.36	-4.40***
Marijuana use				
Age	-.04	-.67	-.04	-.71
Marijuana use	-.28	-2.73**	-.31	-2.98**

TABLE 4. MODEL IIa: ONE YEAR LAG GEE MODEL: SUBSTANCE USE AND FAMILY RELATIONS PREDICTING ACADEMIC MOTIVATION

	Males (n = 293, obs = 692)		Females (n = 301, obs = 729)	
	β	t	β	t
Alcohol use				
Age	-.09	-1.68	-.02	-.41
Alcohol use	ns	ns	-.20	-2.05*
Family relations	ns	ns	.10	3.51***
Cigarette use				
Age	.01	.17	-.01	-.15
Cigarette use	-.45	-4.37***	-.33	-4.00***
Family relations	ns	ns	.09	3.29**
Marijuana use				
Age	-.04	-.66	-.03	-.53
Marijuana use	-.30	-2.94**	-.28	-2.64**
Family relations	ns	ns	.11	3.60***

TABLE 5. MODEL IIb: ONE YEAR LAG GEE MODEL: SUBSTANCE USE AND SELF ESTEEM PREDICTING ACADEMIC MOTIVATION

	Males (n = 250, obs = 463)		Females (n =250, obs = 463)	
	β	ɪ	β	ɪ
Alcohol use				
Age	-.09	-1.25	-.11	-1.66
Alcohol use	ns	ns	ns	ns
Self esteem	ns	ns	ns	ns
Cigarette use				
Age	.05	.68	-.06	-.86
Cigarette use	-.55	-5.10***	-.29	-3.19**
Self esteem	ns	ns	ns	ns
Marijuana use				
Age	.00	.01	-.11	-1.66
Marijuana use	-.40	-3.49**	ns	ns
Self esteem	ns	ns	ns	ns

use of the adolescent. For males and most females, the serial fluctuation in academic motivation was inversely related to the serial fluctuation in alcohol, cigarette, and marijuana use one year later. The interaction between academic motivation and age indicated that for girls 16-17 years of age, there was no relation between academic motivation and the use of alcohol one year later.

In Model IIIa (Table 7), family relationships, interactions between family relationships and academic motivation, as well as interactions of these variables with age, are added to Model III. For males, adding family relationships to the model did not appear to affect the inverse relation between academic motivation and substance use. However, for females, adding family relationships to the model decreased the serial relation between academic motivation and substance use one year later. For younger girls, good family relationships was inversely related to alcohol use one year later, apparently mediating the lagged effect of academic motivation on alcohol use. As seen in Table 7, for boys, the interaction between family relationships and academic motivation and, for girls, the interaction between age, family relationships, and academic motivation, in predicting marijuana use one year later were significant. An examination of these interactions suggested that, for boys and for older girls, the inverse relation between academic motivation

TABLE 6. MODEL III: ONE YEAR LAG GEE MODEL: ACADEMIC MOTIVATION PREDICTING SUBSTANCE USE

	Male (n = 298, obs = 733)						Female (n = 302, obs = 748)					
	Alcohol		Cigarettes		Marijuana		Alcohol		Cigarettes		Marijuana	
	β	ɪ	β	ɪ	β	ɪ	β	ɪ	β	ɪ	β	ɪ
Age	.21	10.06***	.18	7.56***	.15	7.43***	.17	8.81***	.15	5.86***	.10	5.12***
Academic motivation	-.04	-2.27*	-.07	-3.18**	-.05	-3.34***	-.35	-2.91**	-.10	-4.80***	-.06	-3.45***
Age X Academic motivation	ns	ns	ns	ns	ns	ns	.02	2.71**	ns	ns	ns	ns

TABLE 7. MODEL IIIa: ONE YEAR LAG GEE MODEL: ACADEMIC MOTIVATION AND FAMILY RELATIONS PREDICTING SUBSTANCE USE

	Male (n = 294, obs = 728)						Female (n = 305, obs = 806)					
	Alcohol		Cigarettes		Marijuana		Alcohol		Cigarettes		Marijuana	
	β	t	β	t	β	t	β	t	β	t	β	t
Age	.21	9.85***	.17	7.42***	.15	7.42***	.17	8.97***	.16	6.05***	.11	5.27***
Academic motiv.	-.04	-2.49*	-.07	-3.31***	-.06	-3.43***	-.03	-1.53	-.18	-1.33	-.19	-1.47
Family relations	ns	ns	ns	ns	-.02	-1.17	-.27	-3.04**	-.05	-.46	-.08	-.76
Family rel. X Acad. motiv.	ns	ns	ns	ns	-.01	-2.21*	ns	ns	.08	2.76**	.07	2.99**
Age X Acad. motiv.	ns	ns	ns	ns	ns	ns	ns	ns	.01	.70	.01	1.05
Age X Family rel.	ns	ns	ns	ns	ns	ns	.02	2.84**	.00	.13	.00	.63
Age X Family rel. X Acad. motiv.	ns	ns	ns	ns	ns	ns	ns	ns	.00	-2.66**	-.00	-2.82**

TABLE 8. MODEL IIIb: ONE YEAR LAG GEE MODEL: ACADEMIC MOTIVATION AND SELF ESTEEM PREDICTING SUBSTANCE USE

	Male (n = 255, obs = 492)						Female (n = 277, obs =571)					
	Alcohol		Cigarettes		Marijuana		Alcohol		Cigarettes		Marijuana	
	β	t	β	t	β	t	β	t	β	t	β	t
Age	.18	6.37***	.21	1.78	.13	4.66***	-.14	-1.47	.11	3.37***	.11	4.73***
Academic motiv.	ns	ns	1.34	2.16*	-.06	3.04**	ns	ns	-.07	-3.02**	-.05	-2.06*
Self esteem	ns	ns	.07	.71	ns	ns	-.25	-2.86**	-.03	-2.98**	ns	ns
Self esteem X Acad. motiv	ns	ns	-.07	-2.08*	ns	ns	ns	ns	ns	ns	ns	ns
Age X Acad. motiv.	ns	ns	-.09	-2.30*	ns	ns	ns	ns	ns	ns	ns	ns
Age X Self esteem	ns	ns	-.00	-.60	ns	ns	.02	2.83**	ns	ns	ns	ns
Age X Acad. motiv. X Self esteem	ns	ns	.00	2.11*	ns	ns	ns	ns	ns	ns	ns	ns

and later marijuana use was strongest for boys and older girls with good family relationships. For boys and older girls with poor family relationships, the relation was small or negligible. However, for younger girls, the inverse effect of academic motivation on both cigarette use and marijuana use was strongest for those with poor family relationships.

In Model IIIb (Table 8), self esteem is added to the lagged model of academic motivation predicting substance use. Adding self esteem to the model appeared to eliminate the lagged relation between academic motivation and alcohol use for both males and females. For females, self esteem appeared to mediate the relation between academic motivation and alcohol use. Serial fluctuations in self esteem were inversely related to the lagged fluctuations in cigarette use, and for younger girls, lagged fluctuations in alcohol use. An examination of the interaction between age, academic motivation, and self esteem in the prediction of cigarette use for males revealed that self esteem decreased the inverse relation between academic motivation and cigarette use, especially for those in the younger age groups.

DISCUSSION

GEE provides us with an excellent method to examine the relation between substance use and academic motivation. The ability to examine relations across several assessments, incorporating missing data, is essential to the understanding of development and change. In addition, GEE allows us to examine lagged relations between variables, thus furthering our knowledge regarding cause and effect in the understanding of the relation between these two variables.

A lagged relation between substance use and academic motivation one year later was found that was neither mediated nor moderated by either self esteem or family relationships. Similar to previous results (Stein & Bailey, 1973), warm relationships within the family led to increased academic motivation, but only for females. Family relationships did not decrease the effect of substance use on academic motivation, nor did it moderate the effect.

Since not all possible variables were examined in this study, causality between substance use and academic motivation is difficult to infer. Nevertheless, the results support the impaired ability hypothesis--that substance use interferes with the learning process (Newcomb & Bentler, 1986) or decreases academic motivation. In early to mid adolescence many cognitive abilities develop. Substance use in this period could interfere with the development of these abilities. Alternatively, substance use could increase self reflection, which according to Dweck and Elliot (1983), could either lead to new levels of mastery or inhibit mastery. Inhibition occurs when self reflection leads to unflattering conclusions about oneself with the resulting consequence of a decrease in motivation.

A direct path of academic motivation to substance use was not supported by the results of this study, as mediating effects for alcohol use and moderating effects for cigarette and marijuana use for both males and females were found. Although moderated by family relationships and self esteem, academic motivation was inversely related to cigarette and marijuana use one year later. Thus, for cigarette and marijuana use, the results lend partial support to the psychogenic interpretation of the relation between academic performance and motivation, that substances are used as self medication to cope with poor academic performance (Brunswick & Messeri, 1984).

A somewhat surprising result was that for boys and older girls, good family relationships increased the inverse effect of academic motivation on marijuana use. The work of Engel et al. (1987) offers a possible explanation. Parents from families with good relationships are more likely to have high aspirations for their children, particularly their boys and older girls. According to Engel et al. (1987), the discrepancy between parental aspirations for the adolescent and the adolescent's motivation could lead to the use of marijuana, as a reaction to the social pressures received from parents. For younger girls, the pressure to succeed may not be there. Therefore, for younger girls, good family relationships have the expected protective effect, of decreasing the effect of low academic motivation on marijuana use. Good family relationships, for girls, and high self esteem, for boys, also served as protective factors, decreasing the effect of low academic motivation on cigarette use.

A third hypothesis posited to explain the relation between academic motivation and substance use is that both drug use and poor academic achievement are associated with the general psychological tendency of problem behavior, nonconventionality, or general deviance (Bachman et al., 1981; Jessor & Jessor, 1977). This hypothesis was not examined in this study. However, this hypothesis could serve as a possible explanation for the moderating effect of self esteem, for boys, and family relationships, for girls, on cigarette use.

Thus the results of this study supported the impaired ability or impaired motivation hypothesis for cigarette, alcohol, and marijuana use. The psychogenic hypothesis for marijuana use and possibly cigarette use, but not for alcohol use, was also supported, and two mod-

erators of the relation between academic motivation and substance use were identified. The search for additional moderators must continue to fully understand the relation between academic motivation and substance use. The design of prevention and intervention strategies must then incorporate these moderators to both prevent the occurrence of low academic motivation as a necessary outcome of substance use and to protect the individual from the dysfunctional use of substances as a coping mechanism.

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